

Remarks

In the outstanding Office Action, the Examiner has made reference to a claim of priority. The Examiner has rejected claim 10 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The Examiner has rejected claims 1, 8-12, 18-27, 29 and 31-49 under 35 U.S.C. §102(e) as being anticipated by Wetzel et al., United States Patent No. 6,817,410 (hereinafter "Wetzel"). The Examiner has rejected claims 12-21 and 36-49 under 35 U.S.C. §102(b) as being anticipated by Quigley et al., United States Patent No. 6,004,639 (hereinafter "Quigley"). The Examiner has rejected claims 1-11 and 22-35 under 35 U.S.C. §103(a) as being obvious over Quigley in view of Fisher et al., United States Patent No. 6,554,065 (hereinafter "Fisher"). The Examiner has rejected claims 28 and 30 under 35 U.S.C. §103(a) as being unpatentable over Wetzel.

Claims 1-49 are currently pending, of which, claims 1, 12, 22 and 36 are in independent form. Favorable reconsideration of the present Response as currently constituted is respectfully requested.

Priority Claim

The Examiner has stated that "this application appears to claim subject matter disclosed in prior Application No. 60/399,254,

filed 07/29/2002." The applicant has neither claimed subject matter disclosed in the '254 application nor made any indication of a claim of priority to the '254 application. The disclosure of the '254 application is directed to a mesh screen apparatus having a mesh medium with interlocking layers of mesh material positioned over a base pipe. The mesh screen apparatus may include control lines, transport tubes and intelligent completion devices such as gauges, sensors, valve or sampling devices. The '254 application does not teach positioning a sensor within a production interval to sense data relative to a property of the treatment fluid during a treatment process and regulating a characteristic of the treatment fluid during the treatment process based upon the data. In addition, the applicant notes that '254 application is not owned by the applicant or the assignee of the present application. Accordingly, the applicant has not made and does not intend to make a claim of priority to the '254 application. Furthermore, the applicant does not believe that the claimed subject matter in the present application is disclosed or even suggested in the '254 application.

Rejection Under 35 U.S.C. §112, Second Paragraph

The Examiner has rejected claim 10 under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant

regards as the invention. Specifically, the Examiner has stated that the "applicant's summary does not correspond with the disclosure, and confuses the reader as to the scope of the applicants claim." The applicant traverses this rejection. First, the applicant respectfully points out that the section of the patent application entitled "Summary of the Invention" is part of the "disclosure." It is therefore not possible that the "summary does not correspond with the disclosure." Nonetheless, the applicant has amended paragraphs [0010] and [0054] to correspond with one another. No new matter has been added by way of these amendments. Accordingly, the applicant requests withdrawal of the rejection of claim 10 under 35 U.S.C. §112, second paragraph.

Rejections Under 35 U.S.C. §102(e)

The Examiner has rejected claims 1, 8-12, 18-27, 29 and 31-49 under 35 U.S.C. §102(e) as being anticipated by Wetzel. The present invention as claimed in each of the independent claims is directed to apparatuses (claims 1 and 12) and methods (claims 22 and 36) for controlling a treatment process in a wellbore interval that involve positioning a sensor within the wellbore interval to sense data relative to a property of a treatment fluid during a treatment process and regulating a characteristic of the treatment fluid during the treatment process based upon the data. The Examiner has cited column 4, lines 13-34 and item 62 of figure 4 of

Wetzel for this teaching. Specifically, these portions of Wetzel state and depict the following:

Examples of intelligent completions devices that may be used in the connection with the present invention are gauges, sensors, valves, sampling devices, a device used in intelligent or smart well completion, temperature sensors, pressure sensors, flow-control devices, flow rate measurement devices, oil/water/gas ratio measurement devices, scale detectors, actuators, locks, release mechanisms, equipment sensors (e.g., vibration sensors), sand detection sensors, water detection sensors, data recorders, viscosity sensors, density sensors, bubble point sensors, pH meters, multiphase flow meters, acoustic sand detectors, solid detectors, composition sensors, resistivity array devices and sensors, acoustic devices and sensors, other telemetry devices, near infrared sensors, gamma ray detectors, H₂S detectors, CO₂ detectors, downhole memory units, downhole controllers, perforating devices, shape charges, firing heads, locators, and other downhole devices. In addition, the control line itself may comprise an intelligent completions device as mentioned above. In one example, the fiber optic line provides a distributed temperature functionality so that the temperature along the length of the fiber optic line may be determined. (Wetzel, column 4, lines 13-34).

FIG. 4 also shows other alternative embodiments for routing of control lines 60 and for placement of intelligent completions devices 62 such as sensors therein. As shown in previous figures, the control line 60 may extend outside of the sand screen 28. In one alternative embodiment, a control line 60a extends through one or more of the shunt tubes 78. In another embodiment, the control line 60b is placed between the filter media 72 and the shroud 74 in the space 76.

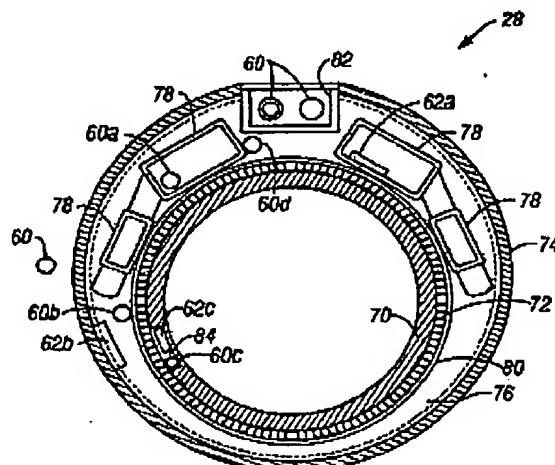


FIG. 4

FIG. 4 shows another embodiment in which a sensor 62a is placed in a shunt tube 78 as well as a sensor 62b attached to the shroud 74. Note that an array of such sensors 62a may be placed along the length of the sand screen 28. In another alternative embodiment, the base pipe 70 may have a passageway 84, or groove, therein through which a control line 60c may extend and in which an intelligent completions device 62c may be placed. The passageway 84 may be placed internally in the base pipe 70, on an inner surface of the base pipe 70, or on an outer surface of the base pipe 70 as shown in FIG. 4. (Wetzel, column 5, lines 12-30).

As seen (figure 4) and described (column 5, lines 12-30) in Wetzel, item 62 is a sensor. As described in Wetzel (column 4, lines 13-34), sensor 62 may be any one of a variety of sensor that are well known in the well completion art. There is no teaching in these excerpt or any other portion of Wetzel, however, directed to controlling a treatment process in a wellbore interval using data obtained during a treatment process relative to a property of a treatment fluid from a sensor within the wellbore interval to regulate a characteristic of the treatment fluid during the treatment process based upon the data.

Instead, Wetzel teaches that once the intelligent completion is in place, a standard gravel pack procedure can be performed. (Wetzel, column 9, lines 40-43). Wetzel describes this procedure with reference to figure 1 as follows:

In a gravel pack operation the packer element 24 is set to ensure a seal between the tubular member 22 and the casing 16. Gravel laden slurry is pumped down the tubular member 22, exits the tubular member through ports in the cross-over 26 and enters the annulus area 34. Slurry dehydration occurs when the carrier fluid leaves

the slurry. The carrier fluid can leave the slurry by way of the perforations 18 and enter the formation 14. The carrier fluid can also leave the slurry by way of the screen elements 28 and enter the tubular member 22. The carrier fluid flows up through the tubular member 22 until the cross-over 26 places it in the annulus area 36 above the production packer 24 where it can leave the wellbore 10 at the surface. Upon slurry dehydration, the gravel grains should pack tightly together. (Wetzel, column 3, lines 1-14).

As stated above, Wetzel describes the intelligent completion as including gauges, sensors, valves and sampling devices including temperature sensors, pressure sensors, flow-control devices and flow rate measurement devices. These sensors can be used to determine if a proper pack has been achieved and whether remedial action should be taken. (Wetzel, column 9, lines 56-57). Wetzel teaches three remedial actions that may be taken, namely, isolating the zone with the failed pack (Wetzel, column 9, lines 60-62), injecting more material into the well (Wetzel, column 9, lines 62-63 and column 10, line 23) and performing additional operations (Wetzel, column 10, line 24). As such, Wetzel teaches that following the gravel packing process, information provided by the sensors can be used to determine whether remedial action should be taken to correct a failed pack. Wetzel does not teach altering a characteristic of a treatment fluid during a treatment process based upon data being collected during the treatment process. As such, independent claims 1, 12, 22 and 36 are not anticipated by Wetzel. In addition, claims 8-11, 18-21, 23-27, 29, 31-35 and 37-49 depend from allowable base claims. Accordingly, the applicant

respectfully requests withdrawal of the §102(e) rejection and allowance of claims 1, 8-12, 18-27, 29 and 31-49.

Rejections Under 35 U.S.C. §102(b)

The Examiner has rejected claims 12-21 and 36-49 under 35 U.S.C. §102(b) as being anticipated by Quigley. As stated above, the present invention is directed an apparatus (claim 12) and a method (claim 36) for controlling a treatment process in a wellbore interval that involve positioning a sensor within the wellbore interval to sense data relative to a property of a treatment fluid during a treatment process and regulating a characteristic of the treatment fluid during the treatment process based upon the data. The Examiner has cited figure 1 and columns 9-12 of Quigley for this teaching. Specifically, these portions of Quigley state and depict the following:

Various optical sensors exist for measuring displacement and position. Simple optical sensors measure the change in retroreflectance of light passing through an optical fiber. The change in retroreflectance occur as a result of movement of a proximal mirror surface.

Additionally, optical sensors can be employed to measure acoustics and vibration. For example, an optical fiber can be wrapped around a compliant cylinder. Changes in acoustic waves or vibrations flex the cylinder and in turn stress the coil of optical fiber. The stress on the optical fiber can be measured interferometrically and is representative of the acoustic waves or vibrations impacting the cylinder.

Mechanical sensors suitable for deployment in the composite tubular member 10 include piezoelectric sensors, vibration sensors, position sensors, velocity sensors, strain gauges, and acceleration sensors. The sensor 72 can also be selected from those electrical

sensors, such as current sensors, voltage sensors, resistivity sensors, electric field sensors, and magnetic field sensors. Fluidic sensors appropriate for selection as the sensor 72 include flow rate sensors, fluidic intensity sensors, and fluidic density sensors. Additionally, the sensor 72 can be selected to be a pressure sensor, such as an absolute pressure sensor or a differential pressure sensor. For example, the sensor 72 can be a semiconductor pressure sensor having a moveable diaphragm with piezoresistors mounted thereon.

The sensor 72 can be also selected to be a temperature sensor. Temperature sensors include thermocouples, resistance thermometers, and optical pyrometers. A thermocouple makes use of the fact that junctions between dissimilar metals or alloys in an electrical circuit give rise to a voltage if they are at different temperatures. The resistance thermometer consists of a coil of fine wire. Copper wires lead from the fine wire to a resistance measuring device. As the temperature varies the resistance in the coil of fine wire changes.

FIG. 1 also illustrates an energy conductor connected to the sensor 72 and embedded in the composite tubular member. The energy conductor 70 can be either a hydraulic medium, a pneumatic medium, an electrical medium, an optical medium, or any material or substance capable of being modulated with data signals or power. For example, the energy conductor can be a fluid impermeable tube for conducting hydraulic or pneumatic energy along the length of the composite tube. The hydraulic or pneumatic energy can be used to control or power the operation of a machine, such as activating a valve, operably coupled to the composite tube. Alternatively, the energy conductor can be an electrically conductive medium, such as copper wire, for transmitting control, data, or power signals to an apparatus operably coupled to the composite tube. The

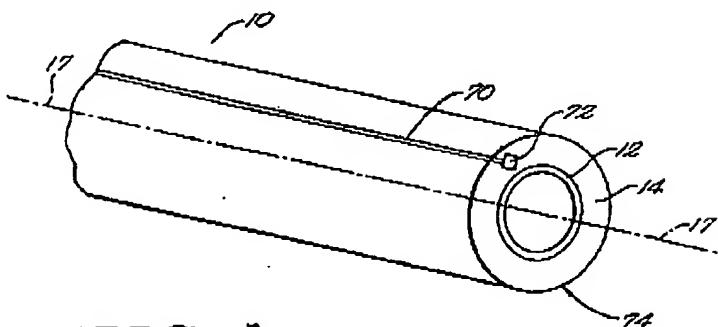


FIG. 1

energy conductor can also be selected from optical medium, such as fiber optics, for transmitting an optical signal along the composite tube. Different types of fiber optics, such as single-mode fibers, multimode fibers, or plastic fibers, may be more suited depending upon the type of sensor 72 that is connected to the conductor 70. The composite tube can include one or more of the described energy conductors.

The hydraulic control line embodiment of the energy conductor 70 used in the composite tube 10 can be either formed of metal or of a polymeric material. In the case of a metal control line, the metals forming the hydraulic line can include, individually or in combination, steel, copper, titanium, lead, or stainless steel. Hydraulic control lines typically have a diameter less than $\frac{1}{4}$ an inch. In the case of a polymeric hydraulic line, the polymeric materials making up the hydraulic line can be thermoplastic or thermoset materials, or metal/polymer composites. For instance, the hydraulic line can be formed of homo-polymers, co-polymers, composite polymers, or co-extruded composite polymers. The polymeric materials forming the hydraulic line are preferably selected from a group of various polymers, including but not limited to: polyvinylidene fluoride, ethylene tetrafluoroethylene, cross-linked polyethylene ("PEX"), polyethylene, and polyester. Further exemplary thermoplastic polymers include materials such as polyphenylene sulfide, polyethersulfone, polyethylene terephthalate, polyamide, polypropylene, and acetyl.

The hydraulic line can also include fibers to increase the load carrying strength of the hydraulic line and the overall load carrying strength of the spoolable composite tube 10. Exemplary composite fibers include graphite, kevlar, fiberglass, boron, and polyester fibers, and aramid.

The hydraulic line embodiment of the energy conductor 70 can be formed to be resistive to corrosive chemicals such as heterocyclic amines, inorganic sulfur compound, and nitrogenous and acetylenic organic compounds. Three types of material, polyvinylidene fluoride ("PVDF"), ethylene tetrafluoroethylene ("ETFE"), and polyethylene ("PE"), have been found to meet the severe chemical exposure characteristics demanded in particular applications involving composite coiled tubing. Two particularly attractive materials for the hydraulic line are the RC10-089 grade of PVDF, manufactured by Atochem, and Tefzel[®] manufactured DuPont.

In other aspects, the hydraulic line embodiment of the energy conductor 70 comprises co-polymers formed to achieve enhanced characteristics, such as corrosion resistance, wear resistance and electrical resistance. For instance, a hydraulic line can be formed of a polymer and an additive such that the hydraulic line has a high electrical resistance or such that the hydraulic line dissipates static charge buildup within the composite tube 10. In particular, carbon black can be added to a polymeric material to form a hydraulic line having a resistivity on the order of 10^8 ohms/centimeter.

As further illustrated in FIG. 1, the composite layer 14 and the pressure barrier 12 constitute a wall 74 of the tubular member 10. The energy conductor 70 is embedded within the wall 74, and the sensor 72 is mounted with the wall 74 of the tubular member. The sensor is connected with the energy conductor such that a signal generated by the sensor can be communicated by way of the energy conductor 70. For instance, the sensor 72 can generate a signal responsive to an ambient condition of the tubular member 10 and the sensor can communicate this signal on the energy conductor 70.

A sensor 72 mounted with the wall is interpreted within the scope of this document to include a sensor attached to the exterior of the wall or a sensor disposed within the wall. For instance, a sensor 72 mounted with the wall 74 can be a sensor disposed within the pressure barrier layer 12 as illustrated in FIG. 12, or it can be a sensor disposed within the composite layer 14 as illustrated in FIG. 13, or it can be a sensor positioned between the pressure barrier layer 12 and the composite layer 14 as illustrated in FIG. 14. Moreover, a sensor 72 mounted with the wall 74 can be a sensor mounted to the exterior of the wall, as shown in FIG. 17.

Pressure barrier layer 12 serves as a pressure containment member to resist leakage of internal fluids from within the composite tube 10. In one embodiment the pressure barrier layer 12 is metallic, in a second embodiment the pressure barrier layer 12 is formed of polymeric materials, and in a third embodiment the pressure barrier layer is formed of a metal/polymer composite such as a metal and polymer foil. The polymeric materials forming the layer 12 can have an axial modulus of elasticity exceeding 100,000 psi. A pressure barrier layer 12 having a modulus exceeding 100,000 psi is preferable as it is indicative of a tube capable of carrying high internal pressure. In addition, a pressure barrier layer with an axial modulus of elasticity less

than 500,000 psi advantageously allows the pressure barrier layer to bend, rather than pull away from the composite layer, as the composite tube is spooled or bent around a reel.

In the case of a metal pressure barrier layer, the metals forming the pressure barrier layer can include, individually or in combination, steel, titanium, lead, copper, or stainless steel. In the case of a polymeric pressure barrier layer, the polymeric materials making up the pressure barrier layer 12 can be thermoplastic or thermoset materials. For instance, the pressure barrier layer can be formed of homo-polymers, co-polymers, composite polymers, or co-extruded composite polymers. Homopolymers refer to materials formed from a single polymer, co-polymers refers to materials formed by blending two or more polymers, and composite polymers refer to materials formed of two or more discrete polymer layers that have been permanently bonded or fused. The polymeric materials forming the inner pressure barrier layer are preferably selected from a group of various polymers, including but not limited to: polyvinylidene fluoride, ethylene tetrafluoroethylene, cross-linked polyethylene ("PEX"), polyethylene, and polyester. Further exemplary thermoplastic polymers include materials such as polyphenylene sulfide, polyethersulfone, polyethylene terephthalate, polyamide, polypropylene, and acetyl.

Pressure barrier layer 12 can also include fibers to increase the load carrying strength of the pressure barrier layer and the overall load carrying strength of the spoolable composite tube 10. Exemplary composite fibers include graphite, kevlar, fiberglass, boron, and polyester fibers, and aramid.

The pressure barrier layer 12 can be formed to be resistive to corrosive chemicals such as heterocyclic amines, inorganic sulfur compound, and nitrogenous and acetylenic organic compounds. Three types of pressure barrier layer material, polyvinylidene fluoride ("PVDF"), ethylene tetrafluoroethylene ("ETFE"), and polyethylene ("PE"), have been found to meet the severe chemical exposure characteristics demanded in particular applications involving composite coiled tubing. Two particularly attractive materials for the pressure barrier layer are the RC10-089 grade of PVDF, manufactured by Atochem, and Tefzel[®] manufactured DuPont.

In other embodiments of pressure barrier layer 12, the pressure barrier layer comprises co-polymers formed to achieve enhanced pressure barrier layer

characteristics, such as corrosion resistance, wear resistance and electrical resistance. For instance, a pressure barrier layer 12 can be formed of a polymer and an additive such that the pressure barrier layer has a high electrical resistance or such that the pressure barrier layer dissipates static charge buildup within the composite tube 10. In particular, carbon black can be added to a polymeric material to form a pressure barrier layer 12 having a resistivity on the order of 10.⁸ ohms/centimeter. Accordingly, the carbon black additive forms a pressure barrier layer 12 having an increased electrical conductivity that provides a static discharge capability. The static discharge capability advantageously prevents the ignition of flammable fluids being circulated within the composite coiled tube 10.

In a further aspect of the invention, the pressure barrier layer 12 has a mechanical elongation of at least 25%. A pressure barrier layer with a mechanical elongation of at least 25% can withstand the increased bending and stretching strains placed upon the pressure barrier layer as it is coiled onto a reel and inserted into and removed from various well bores. Accordingly, the mechanical elongation characteristics of the pressure barrier layer prolong the overall life of the composite coiled tube 10. In addition, the pressure barrier layer 12 preferably has a melt temperature of at least 250.degree. Fahrenheit so that the pressure barrier layer is not altered or changed during the manufacturing process for forming the composite coiled tubing. A pressure barrier layer having these characteristics typically has a radial thickness in the range of 0.02-0.25 inches.

The pressure barrier layer can act as a vehicle for transmitting chemicals that act upon the interior of the well bore, and the pressure barrier layer can also provide a conduit for transmitting fluids that power or control machines operably coupled with the composite tube.

The composite layer 14 can be formed of a number of plies, each ply having fibers disposed with a matrix, such as a polymer, resin, or thermoplastic. Preferably, the matrix has a tensile modulus of at least 250,000 psi and has a maximum tensile elongation of at least 5% and has a glass transition temperature of at least 180 Degrees Fahrenheit. The fibers typically comprise structural fibers and flexible yarn components. The structural fibers are formed of either carbon, nylon, polyester, aramid, thermoplastic, or glass. The flexible

yarn components, or braiding fibers, are formed of either nylon, polyester, aramid, thermoplastic, or glass. The fibers included in layer 14 can be woven, braided, knitted, stitched, circumferentially wound, or helically wound. In particular, the fibers can be biaxially or triaxially braided. The composite layer 14 can be formed through pultrusion processes, braiding processes, or continuous filament winding processes. A tube formed of the pressure barrier layer 12 and the composite layer 14 form a composite tube having a tensile strain of at least 0.25 percent and being capable of maintaining an open bore configuration while being spooled on a reel.

The pressure barrier layer 12, illustrated in FIG. 1, can also include grooves or channels on the exterior surface of the pressure barrier layer. The grooves increase the bonding strength between the pressure barrier layer 12 and the composite layer 14 by supplying a roughened surface for the fibers in the composite layer 14 to latch onto. The grooves can further increase the bonding strength between the pressure barrier layer 12 and the composite layer 14 if the grooves are filled with a matrix. The matrix acts as a glue, causing the composite layer to be securely adhered to the underlying pressure barrier layer 12. Preferably, the grooves are helically oriented on the pressure barrier layer relative to the longitudinal axis 17. (Quigley, column 9, line 12 - column 12, line 65).

As such, Quigley describes a spoolable composite member having sensors and an energy conductor embedded in the composite member. Quigley states that the sensors are structures that sense either the absolute value or a change in value of a physical quantity and that exemplary sensors for identifying physical characteristics include acoustic sensors, optical sensors, mechanical sensors, electrical sensors, fluidic sensors, pressure sensors, temperature sensors, strain sensors and chemical sensors. (Quigley, column 7, line 66 - column 8, line 4). In addition, Quigley states that the pressure barrier layer of the composite tubing can act as a vehicle

for transmitting chemicals that act upon the interior of the well bore and the pressure barrier layer can also provide a conduit for transmitting fluids that power or control machines operably coupled with the composite tube. (Quigley, column 12, lines 27-31). Quigley does not, however, teach altering a characteristic of a treatment fluid during a treatment process based upon data being collected during the treatment process. As such, independent claims 12 and 36 are not anticipated by Quigley. In addition, claims 13-21 and 37-49 depend from allowable base claims. Accordingly, Applicant respectfully requests withdrawal of the §102(b) rejection and allowance of claims 12-21 and 36-49.

Rejections Under 35 U.S.C. §103(a)

The Examiner has rejected claims 1-11 and 22-35 under 35 U.S.C. §103(a) as being obvious over Quigley in view of Fisher. As stated above, the present invention is directed an apparatus (claim 1) and a method (claim 22) for controlling a treatment process in a wellbore interval that involve positioning a sensor within the wellbore interval to sense data relative to a property of a treatment fluid during a treatment process and regulating a characteristic of the treatment fluid during the treatment process based upon the data. Also as stated above, Quigley does not teach altering a characteristic of a treatment fluid during a treatment process based upon data being collected during the treatment

process. Fisher does not cure this deficiency. Fisher is directed to evaluating the integrity of gravel pack after the gravel pack process has been performed. Specifically, Fisher describes disposing a screen in an annulus between the wellbore and a production tubing. A wash pipe is placed inside the production tubing to provide a fluid path for the gravel slurry for gravel packing the screen. A self-contained memory logging nuclear tool is located in the wash pipe below the screen. Fisher states that:

At the conclusion of the gravel pack pipe operation, the tubing 122 is retrieved at a selected speed, thereby allowing the tool 140 to traverse the entire length of the gravel-packed section at such speed (the logging speed). The gamma ray log for the gravel-packed section is recorded in the memory 136 of the tool 140. Upon retrieval of the tool 140 from the well 101, the memory 136 is downloaded and a wellsite plot of count versus depth obtained, which provides the condition of the gravel pack and thus the effectiveness of the gravel pack operation and the integrity of the gravel-packed section. (Fisher, column 5, lines 20-30).

Similar to Wetzel, Fisher is directed to a post gravel pack determination relating to the effectiveness of the gravel pack process. Fisher does not teach altering a characteristic of a treatment fluid during a treatment process based upon data being collected during the treatment process. As such, independent claims 1 and 22 is not rendered obvious by Quigley and Fisher either alone or in combination. In addition, claims 2-11 and 23-35 depend from allowable base claims. Accordingly, the applicant

respectfully requests withdrawal of the §103(a) rejection and allowance of claims 1-11 and 22-35.

The Examiner has rejected claims 28 and 30 under 35 U.S.C. §103(a) as being unpatentable over Wetzel. Claims 28 and 30 depend from allowable base claim 22. Accordingly, the applicant respectfully requests withdrawal of the §103(a) rejection and allowance of claims 28 and 30.

Fee Statement

Compared to the initial filing, in the present Response, the number of independent claims has remained the same and the total number of claims has remained the same. Applicant believes no fees are due for the filing of this Response. If any additional fees are due or overpayment have been made, please charge or credit, our Deposit Account No. 03-1130.

Conclusion

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the outstanding rejections and allow claims 1-49 presented for consideration herein. Accordingly, a favorable action in the form of an early notice of allowance is respectfully requested. The Examiner is requested to call the undersigned for any reason that would advance the instant application to issue.

Dated this 12th day of July, 2005.

Respectfully submitted:



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